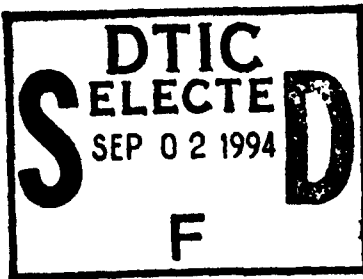


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LOGISTICS SUPPORT CONSIDERATIONS

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5.0 INTRODUCTION

When preparing for the conduct of a Test and Evaluation (T&E) program it is vital that the Flight Test Engineer (FTE) ensure that adequate arrangements are being made for the logistics support of the test program. The FTE must understand the type of tests that will be conducted and then communicate the peculiar needs of his test project to the logistics support community. The FTE must also understand the differences between the logistics support required to conduct his test and the tests of the logistics system. Logistics support is required to keep the test aircraft flying in the required test configuration, while a logistics test evaluates the support system required for the intended user to operate the aircraft. The logistic support system includes support equipment, technical orders, facilities, and manning. Test support requirements may vary drastically depending on status of the aircraft (new aircraft such as C-17, or old aircraft such as F-14D), environmental conditions (cold/hot, salt water/sand, electromagnetic environment, altitude, aircraft carrier, etc.), or repetitive nature of the test (takeoff/landing, accel/decel, or repetitive high time at specific test conditions). Perhaps the most important point to make is that the FTE should locate the logistics experts at their facility, explain the tests that are to be conducted, and task them to provide the support that is required. The FTE cannot arrange the logistics support without expert help. However, these logistics experts may well be able to provide information on spares, training and timing of support so that the FTE can rearrange his planned schedule of tests more efficiently to better match the availability of support. This Section will provide an overview of the types of logistic planning that must be conducted in preparation for such tests and the role of the FTE in defining these support requirements. The conduct of the Logistics T&E program is discussed in Section 23.

5.1 TYPICAL LOGISTICS SUPPORT CONSIDERATIONS

Each T&E program will have its own peculiar logistics support requirements -without exception. If there is a well established logistic support capability manned by knowledgeable personnel, it may be sufficient to just communicate the type of T&E being conducted in order to ensure that adequate logistic support for the aircraft, special instrumentation, and new/peculiar support equipment is available, with back-up, at the test site when

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needed. However, the FTE must evaluate the peculiar circumstances of the test program and then take appropriate action to provide the support that his test will need.

For example, if the aircraft is a new series such as a C-17 the FTE must ensure that engine spares are available to support repetitive tests at high power settings such as takeoffs, numerous climbs to high altitude, level accelerations to determine excess thrust, etc. The engines will proportionally use much higher thrust settings than those experienced during a similar time span in an operational environment. Similarly, the T&E program will utilize proportionally much more braking during tests to determine short field performance will need more brake spares on hand. Aircraft carrier evaluations may require greater spares support of equipment that is sensitive to the high accelerations that will occur during the accelerated launch and recovery sequences. Certain equipments/hardware may fail prematurely because of operations in the shipboard electromagnetic or salt water environment.

Also, the support of new aircraft may require maintenance skills that are not currently available through normal training courses and may require contractor support. Repetitive removals/replacements to check and/or repair test components or instrumentation may far exceed the typical operational requirement for the aircraft. It is incumbent upon the FTE to urge the early training of personnel and try to acquire maintenance resources at a higher level of manning than will normally be used to support an operational version of the test aircraft.

It is vital that T&E peculiar support requirements be communicated to the logistics support community and put in place for the test. Special emphasis is required for long lead-time items such as peculiar support equipment and technical orders.

5.2 OBJECTIVES

With proper test planning and communication, the FTE can alleviate delays to the test program that are caused by the unusually high use of specific logistics support and/or arrange his planned order of tests to match logistics support availability. The FTE must understand the implications of the tests that are being designed and the impact on the logistic support system that is primarily oriented to providing support to operational aircraft (after all, the prime provisioning organization is responsible for thousands of operational aircraft and the special needs of the T&E community are an aberration that they must endure). When conducting tests or qualifying a new aircraft, it is valuable to involve the logistics support community in your test results, because early reliability/maintainability/supportability data will be useful in identifying problems that may be easily corrected early in the program. (See Section 22).

5.3 PROVISIONING CONSIDERATIONS

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Provisioning for T&E, especially of a new aircraft, requires thoughtful consideration of the requirements to provide support for an aircraft that may exist as a one-of-a-kind vehicle with none of the logistics "tail" that will exist for a vehicle that has been in production for several years. The FTEs must ensure that they precisely and exactly communicate the reasons why this particular test program departs from the needs of a "normal" operational aircraft - why do you need twice the normal number of engines for a given number of flight hours, why must you have three times as many sets of brake parts, why do you need four times as many electronic warfare "black boxes" and a dedicated set of support equipment for one aircraft when one set is normally used to support a whole squadron, etc.

The FTE should consider the need for special supply chain requirements, especially for programs with unique equipment under test. These requirements may include a "bonded" storeroom for spare parts support or inventory of special consumables. Further, if there are special maintenance requirements, the FTE may want to set up unique arrangements to expedite maintenance of parts. For instance, a system/part may require special handling, or transportation may need to be expedited to a repair facility or to the component manufacturer for engineering analysis, rather than using normal supply methods. The FTE needs to ensure that a unique/specialized piece of equipment under test doesn't get lost in the supply system. This will be applicable to systems that require maintenance at the intermediate or depot level.

5.4 COMMUNICATIONS REQUIREMENTS

It is incumbent upon the FTEs to communicate their special needs for support to the local logistics organization at a planning meeting and provide them with the information that they will require to convince a test sponsor to provide unusual quantities or amounts of logistic support.

5.5 TYPICAL PRODUCTS OF TEST PLANNING

By successfully communicating their peculiar test support requirements to the local test support activity, and then in turn supporting their efforts with the test sponsor, the FTEs will achieve a test program that will experience a minimal number of delays because of logistics support considerations since all test support requirements will be clearly outlined in the test planning document.

5.6 SPECIAL CONSIDERATIONS

The following are specific areas that the FTE should give increased emphasis in the planning of the flight test program to ensure its success:

- ° Logistics support needs to be planned right up front in a

program. Specific logistic requirements will take a relatively long time to specify and implement (successfully). Logistics support will be especially critical for tests conducted at remote sites such as those required for climatic and all weather tests or carrier suitability trials. (See Section 18). It will be extremely difficult to play "catch up".

° The organization performing logistics T&E should be familiar with the specific program as well as generic logistics requirements. The FTE can use this organization to assist logistics support planning.

° The FTE should work closely with the logistics sponsor (e.g., the Assistant Program Manager for Logistics) to ensure the program needs can be met. This sponsor is normally the person who can help in the early planning and execution of the program to ensure that long lead items are available during the flight test execution phase.

° The novice FTE should understand "normal" operational logistics (at a high level) in order to comprehend how/why specific unique program requirements may be different.

° There may also be logistics support requirements for special test instrumentation, unique diagnostic equipment, etc., that must be considered.

5.7 CONCLUDING REMARKS

Proper logistic support can make the difference between a timely, effective T&E program and one that fails to provide information in a timely fashion. It is the FTEs' responsibility to identify logistic support requirements in a timely fashion and then to communicate these needs to their local logistic support organization. The FTEs must then stand ready (and volunteer their support) to assist the local logistics organization in acquiring the logistic support that will assure the successful conduct of the T&E program.

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LOGISTICS TEST AND EVALUATION

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23.0 INTRODUCTION

The Test and Evaluation (T&E) of logistics is a measurement of the support system's ability to meet predetermined performance requirements. Each element of logistics is equally important and must be given consideration for logistics T&E. Not all elements are applicable to every program acquisition due to the nature of the equipment being procured and subsequently tested. Care must be exercised to ensure that the impacted elements are included in the Logistics T&E process.

In addition to the above elements the logistics T&E process must also integrate the Reliability and Maintainability (R&M) process and the Human Factors (HF) evaluation. Note that the equipment's R&M design features have a great influence over the efficiency of the support system. For example, if the support system is developed concurrent with equipment design and an R or M design feature fails to meet the predicted level of performance, the equipment must be redesigned or modifications must be made to the effected logistics element to compensate for the failed design feature. Therefore, the developer of the support system performance requirements must be thoroughly knowledgeable of the R&M design requirements, the predicted performance, and achieved capabilities.

Closely associated with maintainability, and equally important in some cases to the equipment operator or maintainer, is the impact resulting from Human Factors design. A lack of attention to human factors primarily affects the quantity and type of people needed to operate and maintain the equipment. For example, if the physical size of an item is so large that it requires a four-man lift, or if the controls to operate a system are spread out beyond arm's length from a sitting position, additional manning may be required. (Also see Section 20).

When consideration is being given for logistics T&E, the logistics component of the flight test T&E team must ensure that the following items are well defined in the procurement contract in order to be able to properly evaluate the logistics elements:

- ° Parameters to be measured
- ° Methods for measurement
- ° Timeframes for measurement
- ° Penalties and incentives associated with the achieved demonstrated performance.

Although a Flight Test Engineer (FTE) does not normally get directly involved in the Logistics T&E process, it is vital that he understand how and why Logistics T&E must be integrated into the test program. Systems must be available for ground maintenance evaluation tasks and human factors evaluations, and this non-flying time must be considered when planning the overall test program.

23.1 PERSONNEL, TRAINING, AND TRAINING EQUIPMENT

The most important logistics elements are those which establish and maintain training for the personnel who will operate and maintain the equipment. Without trained personnel, even the most basic equipment with highly efficient support systems will cease to provide the desired operational

effectiveness. In some cases, systems or equipment could even be damaged if operated or maintained by untrained personnel.

23.1.1 Personnel Quality/Quantity

Prior to establishing the personnel requirements in the contract, it is essential that the basic design of the system being procured be fully known by the person establishing personnel requirements. This is necessary because the complexities of the design will determine the required skills and number of personnel needed to operate and maintain it.

New system designs that are on the leading edge of technology may demand the development of new skills or increase the number of personnel required to maintain the system. Either of these situations must be thoroughly researched to assess the impact to the operating activities. The impact of either situation can be contained to acceptable limits by specifying personnel constraints in the equipment manufacturer's contract. The assurance that performance is compliant with contract requirements can only be obtained through T&E.

During contract development, it can be specified that the quantity of personnel shall not exceed the present manning levels, which are expressed in terms of crew size per system and annual maintenance man-hours. This requirement is easier to establish for operators than for maintainers in that crew positions are usually obvious. Measurement of the maintainer requirements can begin early in system development and continue through maintenance task analysis. Each task requirement must be reviewed for applicability and effectiveness. Each task must also be reviewed to determine the number and skills of personnel required to accomplish it. This is a detailed process which involves an analysis of all of the subtasks necessary to accomplish a task. For example, if the task "what to do" is removal of a hydraulic actuating cylinder, the task "how to do" will include the individual subtasks to accomplish the removal of the actuator. The time required to accomplish each subtask must be determined for each person involved. When the analysis of each subtask is complete, the times are summed for each task and subsequently "rolled up" to the next higher equipment indenture level. The "roll-up" continues until the total system maintenance time has been calculated. See Equation 23-1.

Task times must include the time required for isolating the fault; gaining access to the failed part; removing, repairing, and/or replacing the part; adjustments; and repair verification. The maintainability design features are therefore of major importance. Another major element in determining total system maintenance time is task frequency. This element is a function of equipment reliability and, when coupled with task time, assists in determining the annual maintenance man-hours for the system.

23.1.2 Training Materials/Equipment/Facilities

Once operator and maintainer skill requirements have been determined, a comprehensive training program must be developed. Developing the training program includes, but is not limited to, the following elements: identifying training requirements, such as course prerequisites, course length, class size, and milestone schedule; establishing training methods; developing instructional material such as training aids, training equipment, and facilities; presenting and validating the initial courses; and providing instructor training for sustaining the program. Inadequacies in any of these areas could adversely affect system availability. Because each separate element of training must be integrated with the others, it will be difficult to impose contractual constraints on one element without impacting all elements of training. The constraint normally imposed on training is the availability of money.

Training T&E during the engineering and manufacturing development phase of equipment acquisition, and during the early production and deployment phase, is equally difficult because of the lack of contractual constraints or measurable performance criteria.

It is recommended that a comparison of actual task completion times to predicted repair times be made and a training adequacy review be accomplished to determine the effectiveness of the training program. Initial assessment should be accomplished soon after the first operating activity has received its full complement of systems. Follow-up assessments should be accomplished on a routine basis.

Trainers and training equipment development, and subsequent T&E, is a detailed activity that closely parallels the activity associated with a major system acquisition. That is, design engineering, system integration, support system identification, and development, manufacturing, and production are all applicable to trainers and training equipment. Occasionally, however, there are milestone schedules that may require delivery of the trainers and training equipment before or at the same time as the major system. Trainers and training equipment must be identical representations of the system they support; therefore their development must follow system development. This demands the expeditious completion of all engineering and logistics tasks in order to meet the delivery schedules.

23.2 TECHNICAL DATA

Technical data consists of the recorded information regardless of form or character. The Technical Manuals (TMs) and the engineering drawings are the most expensive and possibly the most important data acquisitions made in support of a system. Engineering data such as drawings are crucial to life cycle costs in that they could permit competitive re-procurement of spares, repair parts, and modifications of systems. The TMs are the documentation provided by the manufacturer for the operation and maintenance of the equipment. The requirements for TM development and for TM T&E must be expressed in the contract. The development of TMs must be integrated with training program development in that these are the instructions that will ultimately guide the operator and maintainer. TMs must be totally accurate documents.

23.2.1 Operational and Maintenance Requirements

In the case of some military organizations, a separate contractual document entitled "Technical Manual Contract Requirements" is provided to the manufacturer as an attachment to the logistics statement of work or detail specification. This document identifies the manufacturer's requirements for developing TMs or TM source data by establishing the manuals to be developed, the format to which they are to be developed, their content, the quantity of manuals to be delivered, and the time and place where they are to be delivered. TM source data are usually the functionally validated operating and maintenance tasks which are delivered to a separate organization for publishing to the final format.

TMs or TM source data are usually very expensive but necessary items in every hardware or software procurement. The costs are a function of the quantity of tasks, the complexity of the tasks, the number of illustrations required to support the text, and the format used to produce the manuals. With regard to the quantity of tasks, one method to ensure that the costs are kept to the minimum is to require the equipment manufacturer to accomplish a task analysis and to substantiate the task requirements on known or anticipated failures. This, of course, requires the TM developer to be knowledgeable of the reliability features of the equipment design.

23.2.2 Source Data Technical Evaluation

Because the technical accuracy is so vital to the proper operation and maintenance of the equipment, testing of this accuracy is equally important. A "table top" verification of accuracy is normally followed for TM source data which only provide a system description. This entails nothing more than a grade level check of the test to ensure readability and a verification of the technical accuracy. A "hands on" verification is normally specified for 100 percent of those procedures which detail the operation and maintenance of the system. This verification must be accomplished on a system that is representative of production equipment and completed during the initial T&E phase.

Measurements of accuracy can be based on a percentage of the total number of tasks developed. Time to complete the tasks can also be measured against the predicted times. Additionally, measurements can be made of the errors discovered in the form and format requirements that are expressed in the contract requirements.

23.3 SUPPORT EQUIPMENT

Support equipment (SE) generally falls into one of two categories -items used to repair systems or equipment, and items used to test systems or equipment. The development of SE, as discussed for trainers and training equipment, is also a detailed activity that closely parallels the activity associated with a major system acquisition. All of the design engineering, system integration, support system identification and development, manufacturing, and production tasks are normally applicable when the requirement for a new item of SE has been determined. It must be noted that considerable cost can be controlled or avoided by specifying that a new system be designed to be compatible with existing SE. For example, it could be specified that a new system must be capable of utilizing an existing tow bar, a hydraulic "mule", or an auxiliary power unit. A significant portion of the resources necessary to support a new system may already be available in the existing supply system and the logistician must research this capability and also determine if it is appropriate to require a new system to be compatible with existing capabilities.

T&E of SE is conducted in the same manner as it is for major systems in that requirements are established, plans are written, tests are accomplished, and data are collected and analyzed. Measurable R&M design and system performance requirements are always established in the SE development contract. Human factors such as man-machine interface are also applicable and must be well defined, as are requirements for system interoperability.

23.3.1 System Requirements

When the equipment manufacturer accomplishes a system task analysis and identifies the tasks needed for operation and maintenance of the system, he can also begin to identify the tools and test equipment necessary to support those tasks. The complexity of the task, the extent of system diagnostic aides (Built-In-Test), equipment accessibility, and the physical size of the equipment all have direct influence on the SE requirements. A thorough knowledge of the maintainability design features and the opportunities to change the design can have a significant impact on the tools and test equipment requirements.

23.3.2 Handling Requirements

Handling equipment include such items as slings, skids, dollies, tow bars, and tugs. Human factors are a major consideration in the design of handling equipment. Keeping them simple and limiting their quantity can help contain the costs associated with their procurement and limit the impact to the equipment operator or maintainer. Depending on the maturity of the equipment designs, the logistician can control the costs by specifying that new equipment be designed to be compatible with existing handling equipment. When this is not possible, the procuring activity

must closely monitor the requirements for new handling equipment and maintain approval authority for all new items.

23.3.3 Servicing/Testing/Calibration

The requirements for servicing, testing, and calibration equipment also can be determined through a comprehensive task analysis. For equipment used in servicing and testing tasks, alternative support concepts and a cost benefit analysis could assist in determining the need for new equipment. For example, if the new equipment can reduce system down time (out of service hours) and system readiness is essential, then justification for procurement of the new equipment could be substantiated. When these analyses are being conducted, careful consideration must also be given to the logistics support system requirements for the new SE. These requirements are discussed in paragraph 23.3.5. The requirements for new SE which have unique calibration requirements can also drive the requirement for a new or modified support system and/or an increased quantity of assets. The increase in assets would be generated by the need to have operable SE available for use while the prime asset is undergoing periodic calibration.

23.3.4 Repair

The SE needed for the shop repair or overhaul of failed equipment can be very complex and extensive. Therefore, controlling these SE needs is essential. Considering that these SE items can generate the need for additional special skills, training, and facilities, the costs of their acquisition could outweigh the benefits of repair. In these cases, discarding the failed item could be the most economical decision.

23.3.5 Logistics Support for SE

All too often, the logistics support system for the SE is an area overlooked during equipment acquisition and for T&E after procurement. This area is as important as the major system logistics support system and must be an equal candidate for T&E. The conditions that apply for measuring the performance of the major system logistics support system are applicable for SE. If applicable, the following logistic elements must be given consideration: Personnel, Training, and Training Equipment; TM's, SE for SE, Spares and Repair Parts; Facilities; and Packaging, Handling, Storage, and Transportation. The computer resources such as automatic test equipment, Engine Diagnostic and Recording Systems, etc., must not be overlooked when considering logistics support for SE.

23.4 SPARES AND REPAIR PARTS

Spares and repair parts are those repairable and non-repairable items that are stocked at strategic locations and are used to return a system or repairable part to an operational or serviceable condition. Spares are commonly repairable items such as generators, hydraulic actuators, receivers, brake assemblies, power supplies, etc. When a like item has failed on the in-service system, a spare part is ordered from a stocking point and then used by the maintenance technician to return the system to an operable status. Repair parts are normally non-repairable, consumable items such as gaskets, packings, capacitors, resistors, etc. They are usually stocked at the repair site and treated as pre-expended parts. In other words, they are ordered in bulk quantities that are determined by annual usage. Resupply is based upon established high and low limits.

23.4.1 Estimated Requirements

One of the most difficult problems encountered with this element of logistics is accurately determining spare and repair parts requirements. This problem is more pronounced for systems or equipment that are undergoing development and are to become operational for the first time. These

systems are still in the prototype stage and the spares needed to support their repair during early test activity will be unique to the system's prototype configuration. The range and depth of spare and repair parts must be sufficient to ensure test requirements are met, but cannot be overstocked because of the high costs of procurement and their potential limited application. Usually, the burden of responsibility for sparing the initial testing of newly developed systems is placed upon the equipment manufacturer. The procuring activity must still pay for these spares so provisions are usually made to have the spares upgraded to the configuration that is eventually delivered to the using activities.

Estimating the spare and repair parts to support the early introduction of these systems is usually accomplished with the aid of a spares model. Several computer models are available for this purpose and all rely upon factors such as equipment failure rates, annual operating hours, and repair turn around times.

23.4.2 Lead Time

Lead time refers to the delay encountered for receipt of a newly manufactured part following initial ordering. This delay is attributable to manufacturing and assembling of the part and often includes the time needed for the equipment manufacturer to subcontract with parts vendors. In the cases where major structural items are being procured and requests for metal forgings are involved, the lead time can exceed 18 months. To avoid the possibility of not having the required spare and repair parts available to effect equipment or system repair, lead time must always be considered when the lay-in or resupply of existing stocks is being accomplished.

23.4.3 Prepositioning

It is not uncommon for the stocking point of spares to be at a location different than the system operating location. Stocking points are partially determined by the equipment failure rates, costs, number and location of using activities, transportability, and required stock quantities.

23.4.4 Interim Support

One method frequently used to ensure the availability of spare and repair parts during the time prior to the full provisioning is to require the equipment manufacturer to establish Interim Support. Included in this method of support is the manufacturer's responsibility to provide the spare and repair parts, stock these items at the point of need, issue the items to the using activity, receive the failed item, ship the failed item to a prearranged point of repair, and receive new and repaired items. This method of support is normally for a short duration, one to two years, because of the high cost of maintaining it.

24.4.5 Spare and Repair Parts T&E

Items to be considered for T&E of spares and repair parts would include the following items: system not operationally ready time due to lack of parts; stocking point resupply time; and spares and repair parts availability, (i.e., the percentage of time the ordered or needed item was available within 24 hours after ordering).

23.5 FACILITIES

Facilities can generally be classified into two categories - permanent and mobile. Their uses can cover a diverse range, including maintenance, storage, classroom, berthing, administrative, etc. It is impractical to establish T&E on a permanent facility constructed for its original intended purpose. If the design of the facility does not satisfy its purpose, reconstruction must be accomplished or logistics support will be negatively impacted. This reconstruction will demand

additional expense and delay the intended use of the facility. Therefore, extreme care is always taken to positively identify the construction requirements. Constructing a new military facility normally requires a long period of time. For example, having to construct or modify a facility under the Military Construction Program requires a lead-time of approximately three to five years. A last-minute decision to build the approved facility in a different locale may require extraordinary military department or, in the United States, Congressional action. Unlike permanent facilities, mobile facilities do align with T&E activity. Facility movement from site to site, setup or erection at the new site, and pack-up times can all be specified and later measured. Consideration could also be given for facility expandability and adaptability to new purposes or environments. All are measurable attributes.

23.5.1 Requirements

Facility requirements are determined after a thorough study on the system or equipment being procured has been accomplished and the needs associated with repair, training, administrative, storage, etc., have been established.

23.5.2 Site Survey

After the study identifies the requirements, existing facilities are surveyed to determine their capability to satisfy the new system's needs. The physical size of existing facilities is often verified for acceptability through the use of a model which can generate a floor plan representative of the facility. The foot print of the new equipment is then added to the floor plan to determine the used and available space. These models are relatively inexpensive and should be considered for facility T&E.

23.6 PACKAGING, HANDLING, STORAGE, AND TRANSPORTATION (PHS&T)

PHS&T is the combination of resources, processes, procedures, and methods necessary to ensure that all system, equipment, and support items are preserved, packaged, handled, and transported properly. This is an area often overlooked as a candidate for T&E and for the role it plays in overall system supportability. The user of provisioned spares and repair parts, however unknowingly, depends very heavily on the serviceability of those items. He expects them to be in a ready-for-use condition upon receipt.

To ensure equipment serviceability, PHS&T planning must begin early in the equipment design process. The packaging and storage requirements for an item must align with available or planned transportation methods and storage facilities.

An inexpensive approach for T&E of PHS&T can also be accomplished through modeling in a manner similar to that used for facilities. Consideration should be given for requirements that identify space, weight, adaptability for use with standard size reusable containers, availability of construction materials for special packaging, and special requirements for handling equipment such as forklifts, cranes, dollies, slings, etc. Contract requirements established at the beginning of the equipment design effort can ensure packaging or modularizing of the equipment to meet the using activities needs.

23.7 DATA COLLECTION/REDUCTION

Data collection during logistics T&E, as during any other major system T&E activity, depends heavily on data accuracy. A data collection system must be established and be in place prior to initiation of test activity, data points to be collected must be known by the data collectors, and knowledgeable personnel must be available to assess the data.

Although all major test activities and equipment manufacturers generally have their own systems for data collection, occasional review of those systems should be accomplished. This is especially true if two independent activities are expected to compare test results. Whatever system is considered acceptable, it should be capable of providing output which will permit the assessment of the impact that the new equipment may have on the existing support system. The system should also permit readiness impact assessments based upon the non-availability of individual support resources.

23.8 SPECIAL CONSIDERATIONS

With the advent of Computer-aided Acquisition and Logistics Support (CALS), the development and delivery of engineering and logistics products changes from the traditional paper form to a digital form. This requirement demands the availability of compatible computer resources and software, in that the delivery format specified can be direct electronic transfer through telecommunications, 9-track tape, 3.5-inch or 5.25-inch floppy disk, or CD ROM.

The impact to the ultimate users of these products, the operator and maintainer, must be thoroughly researched in order to reduce the shock of introduction. The logistic element where the greatest impact can be made, and the greatest shock can be felt, is in TMs. Eliminating the manuals that provided the operating and maintenance instructions that have been relied upon in the past and replacing them with on-screen representations generated by a personal computer could be traumatic for the user. Preparing the operator and maintainer to readily accept these products can best be accomplished by extensive user training and incremental phasing-in of the digital data. This method of introduction produces a greater acceptance by establishing user confidence in the accuracy and availability of the information. The importance of product accuracy and reliability of the computer resources cannot be over stressed. Any errors in the procedures or failures in the equipment will quickly erode user confidence. A thorough T&E of these products is essential prior to introduction.

23.9 CONCLUDING REMARKS

Some form of T&E is applicable to every logistic element. T&E will ensure that the logistics support system performance requirements are obtainable. The engineering design, especially R&M, exerts a great influence over the efficiency of the support system. A thorough knowledge of the equipment's intended design by the logistician is essential prior to establishing the support system performance requirements. This design knowledge will also enable an assessment of design impact on the logistics support system. Effective logistics T&E can only be accomplished if the requirements are positively established in the equipment manufacturer's development contract.

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$$AT_1 + AT_2 + \dots AT_n = _AT_i$$

Where AT_i = Time in man-minutes to perform
a Skill Level for task i.

Therefore, for Skill Levels A ... C the total time (TT) in hours is defined as follows:

$$_AT_i + _BT_i + _CT_i = TT \qquad 60 \quad 60 \quad 60$$

Equation 23-1